

NOTEWORTHY COLLECTIONS

CALIFORNIA

ALTERNANTHERA PHILOXEROIDES (Mart.) Griseb. (AMARANTHACEAE).—Contra Costa Co., Winter Island, 10S 600860N 4212403E (38.053758, –121.850386; utms converted with Yellowstone Research Coordination Network 2019), CDFA PDR MVAP50000489, SurveyID MAX1807310959, California Division of Boating and Waterways Management Site 133, 31 July 2018, *A. Ougzin and J. Mauldin s.n.* (CDA). Sacramento Co., Sacramento River, populations at pylons anchoring floating dock under Tower Bridge, 38.58014, –121.507721 (lat/long approximate from GoogleEarth Pro version 7.3.0.3830), CDFA PDR MVAP06805524, CalFlora ID po65735, California Division of Boating and Waterways Management Site 290, 22 September 2017, *G. Walden s.n.* (CDA); Sacramento River, floating dock under Tower Bridge, 38.579968, –121.507755 (lat/long approximate from GoogleEarth Pro version 7.3.0.3830), CDFA PDR MVAP50000219, California Division of Boating and Waterways Management Site 290, 19 July 2018, *G. Walden s.n.* (CDA); Sherman Island, alligatorweed with *Colocasia esculenta* (L.) Schott (Araceae), *Eichhornia crassipes* (Mart.) Solms (Pontederiaceae), *Iris pseudacorus* L. (Iridaceae), *Ludwigia* sp. (Onagraceae), 10S 606711E 4210604N (38.036877, –121.783982), CDFA PDR MVAP50000499, SurveyID Alligator1808231, California Division of Boating and Waterways Management Site 122, 23 August 2018, *A. Ougzin and J. Mauldin s.n.* (CDA); Sacramento River, 10S 630796E 4256104N (38.443645, –121.501216), CDFA PDR MVAP50000484, California Division of Boating and Waterways Site 249, CDFA Noxious Weed permit number 3460 (form 66-026), 15 January 2019, *J. O'Brien, J. Martinez, and M. Kwong s.n.* (CDA). San Joaquin Co., southern Delta near the confluence of Salmon Slough and Old River, identified by D. Kratville from nutria camera trap, 37.80596, –121.40878, CDFA PDR MVAP50000482, 26 November 2018, *D. Kratville, S. Maring, and K. Norberg s.n.* (CDA). Solano Co., east bank Montezuma Slough, Montezuma Wetlands across from Grizzly Island, fringing emergent tidal wetland, floating mat and plants rooted in sediment, levee bank, 38.096641, –121.894088, CDFA PDR MVAP06805556, CalFlora ID po62366, California Division of Boating and Waterways Management Site 850, 25 August 2017, *B. J. Grewell and C. J. Futrell s.n.* (CDA, DAV); fringing emergent tidal wetland west bank of in-channel island, Montezuma Slough, Suisun Marsh at Grizzly Island Wildlife Area, 38.114364, –121.8913, CDFA PDR MVAP06805557, ALPH-1, CalFlora ID po62369, 12 September 2017, *B. J. Grewell and C. J. Futrell s.n.* (CDA, DAV); west side Montezuma Slough, Suisun Marsh immediately north of Grizzly Island Wildlife

Area, southwest of Mein's Landing, floating mat in backwater area at edge of in-stream island, rooted in sediment, with *Azolla filiculoides* Lam. (Azollaceae), *Schoenoplectus californicus* (C.A. Mey.) Soják (Cyperaceae), 38.135535, –121.914477, CDFA PDR MVAP06805558, CalFlora ID po62373, 12 September 2017, *B. J. Grewell, C. J. Futrell, and J. Castillo s.n.* (CDA, DAV); Montezuma Slough, Suisun Marsh at Grizzly Island Wildlife Area, east side of small channel within in-stream island, 38.128201, –121.91626, CDFA PDR MVAP50000448, ALPH-4, 3 October 2018, *B. J. Grewell and C. J. Futrell s.n.* (CDA, DAV); Montezuma Slough, Suisun Marsh at Grizzly Island Wildlife Area, channel side of levee Montezuma Wetlands property immediately east across channel from Grizzly Island Wildlife Area fishing piers, 38.096641, –121.894088, CDFA PDR MVAP50000449, ALPH-1, 3 October 2018, *B. J. Grewell and C. J. Futrell s.n.* (CDA, DAV); Montezuma Slough, Suisun Marsh, west side of in-stream island at Grizzly Island Wildlife Area, south of ALPH-3, 38.127671, –121.916212, CDFA PDR MVAP50000450, ALPH-2, 3 October 2018, *B. J. Grewell and C. J. Futrell s.n.* (CDA, DAV); Montezuma Slough, Suisun Marsh, west side of in-stream island at Grizzly Island Wildlife Area, north of ALPH-2, 38.128027, –121.916337, CDFA PDR MVAP50000451, ALPH-3, 3 October 2018, *B. J. Grewell and C. J. Futrell s.n.* (CDA, DAV); Decker Island, intertidal area, in tules, not visible from water, in sand, 38.090850, –121.710820, California Department of Water Resources, CDFA PDR MVAP50000218, Division of Boating and Waterways Site 176, 11 July 2018, *J. Van Susteren JVS 18-54* (CDA); Montezuma Slough, Second Mallard Slough, upstream of second major branch, 38.190283, –122.006692, UC Davis Fish Study, CDFA PDR MVAP50000220, 10 July 2018, *T. O'Rear s.n.* (CDA); Montezuma Slough, Second Mallard Slough, upstream of second major branch, 38.190283, –122.006692, UC Davis Fish Study, CDFA PDR MVAP50000366, 16 August 2018, *T. O'Rear s.n.* (CDA); Cordelia Slough, just downstream of the railroad bridge, 38.152497, –122.088564, UC Davis Fish Study, CDFA PDR MVAP50000367, 16 August 2018, *T. O'Rear s.n.* (CDA); Montezuma Slough, Second Mallard Slough, upstream of second major branch, 38.190283, –122.006692, UC Davis Fish Study, CDFA PDR MVAP50000375, 11 September 2018, *T. O'Rear s.n.* (CDA); Cordelia Slough, just downstream of the railroad bridge, 38.152497, –122.088564, UC Davis Fish Study, CDFA PDR MVAP50000376, 13 September 2018, *T. O'Rear s.n.* (CDA); Montezuma Slough, Second Mallard Slough, upstream of second major branch, 38.190283, –122.006692, UC Davis Fish Study, CDFA PDR MVAP50000444, 11 October 2018, *T. O'Rear s.n.* (CDA); Montezuma Slough, Second

Mallard Slough, upstream of second major branch, 38.190283, -122.006692, UC Davis Fish Study, CDFA PDR MVAP50000487, 12 November 2018, *T. O'Rear s.n.* (CDA); Montezuma Slough, Second Mallard Slough, upstream of second major branch, 38.190283, -122.006692, UC Davis Fish Study, CDFA PDR MVAP50000488, 4 December 2018, *T. O'Rear s.n.* (CDA). Yolo Co., Sacramento River, in river on submerged pilings, east of Riverwalk Trail, just before (south) of Subtile Sculpture, 38.57657, -121.511472, CDFA PDR MVAP50000441, 20 October 2018, *G. Walden s.n.* (CDA); Sacramento River along banks, collected from 38.575783, -121.512295 to 38.574711, -121.513450, CDFA PDR MVAP50000483, 17 January 2019, *G. Walden s.n.* (CDA); Sacramento River under Mill Street Pier, 38.57317, -121.515169, CDFA PDR MVAP50000486, 27 February 2019, *G. Walden s.n.* (CDA).

Previous knowledge. *Alternanthera philoxeroides* (common name alligatorweed; basionym *Bucholzia philoxeroides* Mart., synonyms *Achyranthes philoxeroides* [Mart.] Standl., *Telanthera philoxeroides* [Mart.] Moq.) is native to South America, invasive, and a noxious weed worldwide (EPPO 2016; Bartlett 2018). In North America, *A. philoxeroides* occurs in México (Mora-Olivo and Sánchez-del Pino 2014) and the United States (Clemants 2004; USGS 2019). In the USA, *A. philoxeroides* has been reported from Alabama, Arkansas, California, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, and Virginia (Brown and Carter 1946; Coulson 1977; SEINet 2019; USDA, NRCS 2019; USGS 2019).

In California, *A. philoxeroides* was first documented in 1940 in Los Angeles Co. (CDA-0023860), determined as a noxious weed infestation requiring management in 1956 (CDA-0003253), and eventually found in waterways of Riverside (CDFA PDR 1036436, duplicates deposited at RSA, SD, UCR) and San Bernardino cos. (reports only, no supporting voucher specimen; Roberson 1996). *Alternanthera philoxeroides* was first documented in Tulare Co. in 1965 (CDFA 1965), spreading in Mill Creek to adjacent Kings Co. by 1969 (CDFA 1969). *Alternanthera philoxeroides* occurred in San Diego Co. in 1986 (CDFA PDR 478124, CDA-0003251) and was eradicated by 1994. The Los Angeles and Kings/Tulare county infestations are still extant and under management by County Agriculture Commissioners (CDFA 2019b). *Alternanthera philoxeroides* is an A-rated Noxious Weed [3 CCR § 4500] and Restricted Noxious Weed Seed [3 CCR § 3855] in California. The counties of Kings, Los Angeles, Riverside, and Tulare are alligatorweed eradication areas [3 CCR § 3960].

Alternanthera philoxeroides is adaptive, competitive, and plastic (Sosa et al. 2008). It is a perennial, stoloniferous, mat-forming macrophyte that roots at nodes; it reproduces vegetatively and can spread

rapidly by hydrochorous dispersal of plant fragments (Keffer 1982; CDFA 2019a). Alligatorweed has diagnostic hollow stems in aquatic situations (from submerged or emerged conditions), and solid stems or solid nodes in terrestrial situations. Stems can be glabrous or with two lines of trichomes, and can have tufts of hair at the nodes. Leaves are opposite, sessile to slightly clasping, entire-margined, and can be variable in shape and size (Sosa et al. 2008). Inflorescences are axillary or terminal, peduncled, globose heads of densely clustered flowers. Mature fruits have not been reported in North America.

Alternanthera philoxeroides is a significant invasive species for California. It is highly competitive, displaces non-native and native wetland and riparian species, and causes severe impacts to infrastructure of waterways and irrigation systems (Bartlett 2018). Since management efforts for Los Angeles began in 1956, continued cooperative efforts, surveys, and funding have been required to control the more than 125 net acres (Hill and Donley 1973), and although still present in Los Angeles Co., the total area infested has been reduced to less than an acre (Kaplan 1994, Senzai 2006). Invasion and establishment of *Alternanthera philoxeroides* into new counties and water systems of California has long-term economic and environmental costs for management.

Significance. These are the first vouchers of *A. philoxeroides* from the Sacramento-San Joaquin Delta, Suisun Marsh, and its tributaries and the first collections in wildlands of Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties. A previous specimen from Danville, Contra Costa Co. is not considered a naturalized population, although information about this specimen is limited (hereafter Danville specimen, garden situation, CDA-0020558, 23 June 2005; CCH 2019; CDFA 2019b). Additional observations and reports have been made by members of the general public and by California State and Federal agencies as part of survey and management efforts; supporting voucher specimens are not currently known or available for all reported sites (CalFlora 2019; CDFA 2019a; CDFW 2019b; iNaturalist 2019).

Collections from 2017 by USDA-ARS in Montezuma Slough in Solano Co. were the first occurrences documented for Suisun Marsh, and outside of any previous known occurrences in California under management (i.e., Los Angeles Co. and area, and Kings/Tulare cos.). The 2017 collection by CDFA at Tower Bridge in Sacramento Co. was the first voucher within the legal boundary of the Sacramento-San Joaquin Delta. These vouchered finds led to inter-agency coordination to complete a risk assessment and determination as an invasive aquatic plant (Bartlett 2018) for management in California (O'Brien 2018; Sandoval 2019).

In total, these finds document a range expansion greater than predicted for California by Julien et al. (1995). The population at the Tower Bridge in

Sacramento Co. (at 38.58°N) represents the northernmost documented site for *A. philoxeroides* in California. This range expansion in California is similar to that documented for *A. philoxeroides* in China, where the species has spread to 36.7°N, five degrees latitude beyond the predicted northern limit (Julien et al. 1995; Liu et al. 2012; Liu et al. 2019). For North America, the northernmost occurrence is in Maryland at 38.98°N [16 September 2014, *J. D. Hall JH2014.09.16-07 with N. G. Anderson MARY1000869*; available via SEINet (2019)].

Limits for *A. philoxeroides* in the Sacramento, American, and San Joaquin rivers of California are not yet known. Heightened awareness is needed for early detection in the Sacramento-San Joaquin Delta, Suisun Marsh, and its tributaries, and in irrigated and flood crops of the Great Central Valley. The Suisun Bay drainage was included in climate matching analyses due to the Danville specimen for California (see Figs. 5–7 in USFWS 2018); those analyses indicate additional available climate matches outside of vouchered and reported sites for *A. philoxeroides* invasions. Re-evaluation of datasets and models for predicting invasion distributions are needed for this taxon, especially for pest risk assessments and introductions of biocontrol organisms into California.

If plants suspected to be *Alternanthera philoxeroides* are observed, please notify your nearest California Agricultural Commissioner office immediately [<https://www.cdfa.ca.gov/exec/county/countymap/>]. Submit plant samples to the Agricultural Commissioner office for official determination and voucher at the CDFA Plant Pest Diagnostic Center, and to coordinate interagency management response.

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